3-22-2021 LECTURE NOTES

ANGULAR MOTION

$\ell = r\theta$ $\quad \theta \Rightarrow$ IN RADIANS $\quad s = \ell$ ON A CIRCLE

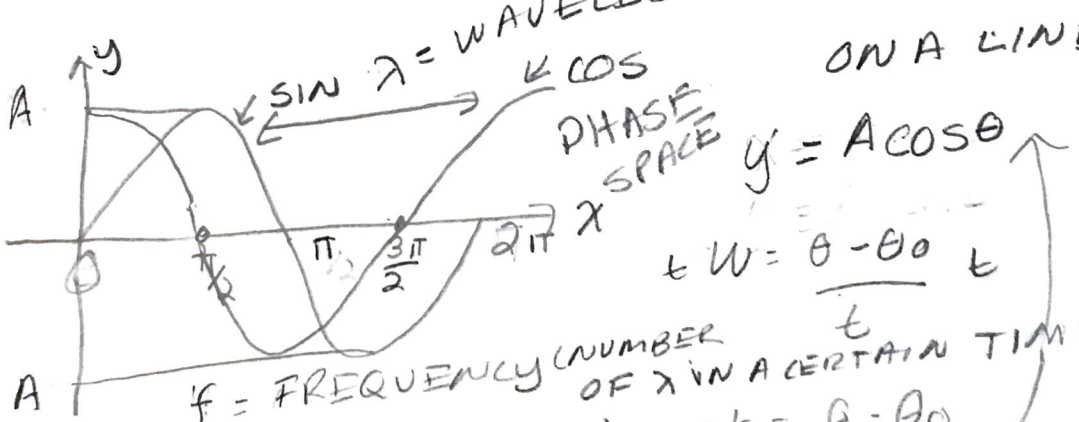
$v = r\omega$

$a = r\omega^2 = r\alpha$

$\bar{\omega} = \frac{\omega + \omega_0}{2} = \frac{\theta - \theta_0}{t}$ $\quad \left(\bar{v} = \frac{v + v_0}{2} = \frac{\ell - \ell_0}{t}\right)$

$\theta = \frac{\alpha t^2}{2} + \omega_0 t$ $\quad \left(\ell = \frac{a t^2}{2} + v_0 t\right)$

$\omega^2 - \omega_0^2 = 2\alpha\theta$ $\quad (v^2 - v_0^2 = 2a\ell)$



ON A LINE

$y = A\cos\theta$

$\omega = \frac{\theta - \theta_0}{t}$ $\quad t$

$\omega = 2\pi f$

$\omega = \frac{2\pi}{T}$ INSTANTEOUS

t CAN EQUAL T (PERIOD)

$\omega t = \theta - \theta_0$

$+\theta_0$

$\omega t + \theta = \theta$

$\theta_0 = \frac{\ell_0}{r} = \frac{2\pi x_0}{\lambda} = K x_0$

$\boxed{K = \frac{2\pi}{\lambda}}$ $\quad K$ = WAVE NUMBER

$y = A\cos(\omega t + \theta_0)$

$\boxed{y = A\cos(\omega t + K x_0)}$

$\boxed{v_y = -A\omega\sin(\omega t + K x_0)}$

$\boxed{a_y = -A\omega^2\cos(\omega t + K x_0)}$

$\frac{dy}{dt} = \frac{d(\cos\theta)}{dt} = -\sin\theta$

$\frac{d^2y}{dt^2} = \frac{d(\cos\theta)}{dt} = -\cos\theta$

IF AN OBJECT IS MOVES 5.00π RADIANS ON A CIRCLE IN 3.00 S; WHAT IS THE ANGULAR VELOCITY AND ACCELERATION? IF IT TRAVELS 3.00π RADIANS MORE WHAT IS ITS FINAL VELOCITY?

$$\omega = \frac{\theta - \theta_0}{t} = \frac{5.00\pi \text{ RAD}}{3.00 \text{ S}} = 5.24 \text{ RAD/S}$$

$$\alpha = \frac{\omega - \omega_0}{t} = \frac{5.24 \text{ RAD/S}}{3.00 \text{ S}} = 1.75 \text{ RAD/S}^2$$

$$\omega^2 - \omega_0^2 = 2\alpha\theta$$

$$\omega = \sqrt{2(1.75 \text{ RAD/S})(3.00\pi \text{ RAD}) + (5.24 \text{ RAD/S})^2}$$

$$= 7.77 \text{ RAD/S}$$

IF A MASSLESS STRING HAD A $\lambda = 0.21 \text{ m}$ AND LEGTH OF 2.00 m, WHAT IS K? IF THE AMPLITUDE IS 1.5m AND WAND TIME FROM ABOVE, WHAT IS y, v_y, AND a_y?

$$k = \frac{2\pi}{0.21 \text{ m}} = 9.52\pi/\text{m}$$

$$y = (1.5\text{m}) \cos\left(-(5.24/\text{s})(3.00\text{s}) + (9.52\pi/\text{m})(2.00\text{m})\right)$$

$$= \boxed{1.49 \text{ m}}$$

$$v_y = -(1.5m)(5.24/s)\sin((5.24/s)(3.00s) + (9.52\pi/m)(2.00m)$$

$$= \boxed{-1.07 m/s}$$

$$a_y = -(1.5m)(5.24 m/s)^2 \cos((5.24/s)(3.00s) + (9.52\pi)(2.00m)$$

$$= \boxed{-40.8 m/s^2}$$